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ACCLIMATIZATION OF POPULATIONS TO ARCTIC CONDITIONS

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During the last 30 years, giant industrial centers have been developed on the heretofore uninhabited expanses of the extreme north with the result that the population has increased tenfold.

In connection with these changes there is an urgent need to study the acclimatization of the peoples who have populated these territories. In 1946, the Academy of Medical Sciences included this problem in the plan of the Institute of General and Public Hygiene.

To plan this study, the institute, with the aid of the Main Administration of the Northern Sea Route, dispatched an expedition to the Arctic in 1946. The expedition included Professors I. A. Arnol'di and V. V. Yefremov, and Assistant Professor Kandror. Investigations were carried on in the Arctic at a number of inhabited points along the shore of the Kara Sea. The material collected and the observations made by the expedition permit certain preliminary generalizations.

The Arctic climate has certain characteristics which affect the human organism. These characteristics are inclemency, changeability, high relative humidity with a low absolute humidity, strong blizzard winds, and frequent fluctuations of barometric pressure.

At Dickson Island, the maximum direct solar radiation occurs at noonday and amounts to 1.42 calories per minute per square centimeter. In the North, diffused radiation plays a more important role in solar heat than in southern latitudes, (for example, the Crimea) chiefly because of the increased fine, thin clouds which diffuse radiation energy readily and because of a high snow albedo, i.e., of reflected radiation, which reaches 91 percent. Diffused radiation constitutes 67 percent of the total amount of solar heat.

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Actinometric observations have established the presence of a large amount of ultraviolet radiation in the atmosphere. The population realizes the biological importance of these rays. We noticed that at midnight of the polar day, when the mists are dispersing, mothers awaken their children and take them out of doors to expose them to the action of ultraviolet rays. Accompanied by a high snow albedo and a considerable transparency of the atomsphere, the large number of ultraviolet rays cause a strong glare which in the spring gives hunters and fishermen so-called snow blindness resembling the electroophthalmia encountered among welders.

The amount of solar heat in the polar day is relatively high, but a considerable part of it is expended in melting snow and ice. Consequently, from the view point of convective heat, the effect is small. Permafrost covers nine tenths of the Arctic territory, the soils of which have an increased acidity and are poor reflectors of heat. These three factors create an invariable negative radiation and are the cause of the low average annual temperature of the atmosphere.

Arctic climate is not uniform. Individual climatic regions differ sharply in their meteorological complex and in atmospheric phenomena.

At Dickson Island the sun disappears on 11 November and reappears on 1 February, while at Igarka the polar night lasts only 8 days, from 18 to 26 December. In the Arctic the limits of temperature fluctuation between day and night and summer and winter are less than in other latitudes and the annual temperature range is characterized by the absence of a sharply pronounced minimum in winter and maximum in summer. For example, in Yakutsk the temperature falls to minus 70 degrees centigrade in the winter, while in the Arctic the minimum is around minus 50 degrees. The cold pole is not in the Arctic but in Verkhoyansk, in northeastern Siberia. In the southern part of Yakutsk, the temperature rises to plus 40 degrees in the summer, and in the Arctic only to plus 16 or 18 degrees. In August, the warmest month in the Arctic, the average temperature is approximately plus 3 degrees, and at Dickson plus 5.1 degrees.

Although periodical changes in Arctic temperatures are not great nonperiodical changes are extraordinarily marked as a result of the movements of masses of warm and cold air over the earth's surface. At Dickson a case is recorded, where, in the course of a single day, air temperature changed 22 degrees in 10 hours. In Yakutsk, freezes generally occur with calm weather. On the other hand, freezes in the Arctic, although less intensive, are accompanied by a sharp blizzard wind. Frequent mists, especially in the summer, are another characteristic of Arctic climate. The mists are a result of the combination of low temperatures with high relative humidity. The average annual relative humidity is 81-88 percent. At Dickson, as many as 20 days in the month of July are misty, and in summer the mists are very heavy.

The snow blanket forms early. On the Dickson Island, snow lasts for 266 days and reaches a depth of 30-32 centimeters. Snowstorms occur most frequently from November to April and consist mainly of blizzards, during which extremely fine powdery snow penetrates clothing and induces chills. Wind velocity reaches 30 or more meters per second.

The polar night is characterized by a number of factors which have a tonic effect on the organism. These factors are the electrical condition of the atmosphere (the strong aeroionization), the ozonization, and the brilliant Northern lights which are an unusual and magnificent spectacle that always inspires Arctic workers. The widespread traumatism during Arctic operations can be explained in part by the phenomena of refraction of light rays.

During the last 10 years a very interesting phenomenon has been observed in the Arctic especially in the western section, namely, the advent of warmer weather.

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The influence of Arctic climate on man, the degree of his acclimatization, his well-being, his psychophysiological condition, and his health were studied by means of questionnaires and selective interrogations of a group of Arctic workers on Dickson Island and at Slobodskiy Bay. The majority of Arctic workers examined came from the northern regions of the USSR, chiefly from Siberia. The others came from the central area and only a few from the southern regions.

We were able to establish that acclimatization and a long life under Arctic conditions is possible for immigrants. But it should be noted that this expectancy cannot be accepted as equally applicable to all groups of arrivals. The groups must be differentiated according to two factors: (1) place of former residence (climatic zone), and (2) individual psychophysiological characteristics. The acclimatization of peoples of the northern regions (Siberia) of the USSR is the most effective, that of immigrants from the central zone is less so, and finally, that of southerners is extremely complex.

The work-rest schedule in the Arctic is determined by climatic conditions to a greater degree than in continental USSR. The schedule of work or watch hours changes four times a year depending upon rotation of the sun; the polar day, the polar night and the transition periods. During the polar day and the polar night work hours are established by Moscow time. During the transitional periods they are set by Arctic time to take advantage of maximum natural light for better working conditions. During each of these changes, a certain period is necessary for readjusting to the new work-rest schedule. As a rule, new arrivals in the Arctic do not have a regular sleeping schedule. It takes from one to one and a half years to establish a schedule that is relatively regular. But for the majority of the population, the schedule still differs in the course of the polar day and the polar night. As a rule, the Arctic worker sleeps more during the polar night than during the polar day. Work is not uniform in the different seasons and is usually more intensive during the course of the polar day.

An exceptionally important role in acclimatization is played by the psychophysiological characteristics of Arctic workers, for example, excitability, unsociability toward fellow collective workers, etc. Under Arctic conditions, feet freeze at work even in the summer because of the permafrost layer. The so-called active layer does not exceed an average of 40 centimeters at Dickson; as a result, workers often wear felt boots in their workshops even in the summertime.

Kolkhoz brigades and individual trader-trappers engage in hunting and fishing. At the trade-hunting stations in Slobodskiy Bay we examined these trader-hunters who track fox and hunt seal in winter and fish and hunt deer in summer. The trader is almost always subject to the dangers of the severe Arctic climate. He makes 40-50 kilometer treks in the winter, traveling by dog sled from trap to trap, guided only by his senses.

Among the common illnesses encountered in the Arctic it is possible to isolate a number related to specific local conditions. Traumata are important both as to frequency and seriousness. Although traumatism may occupy first place, the seriousness of the illness is less due to the selection of healthy people for work in the Arctic. In the case of wounds healing takes place, without festering, by primary contraction. Purulence occurs slowly, but reparative processes are sluggish.

There is a high rate of appendicitis which is believed due to consumption of canned goods which is widespread in the Arctic. Arthralgia, due to conditions created by the permafrost and changeability of climate, constitutes about 13 percent of the diseases examined. Arthralgia often attacks without causing fever or visible change in the joints.

The distribution of grippe, especially in heavily populated areas, is almost anologous to its distribution in continental USSR. However, there is a slight decrease in grippe cases during the polar night and a relative increase during the polar day. On the individual peninsulas and in sparsely populated localities there is no grippe. It is caused entirely by contact with new arrivals at which time grippe epidemics spread fast and without complications. Due to selection of personnel, diseases of the cardiovascular system are rare, as is tuberculosis. In connection with certain diseases, steady improvement and even cures have been noted after a stay in the Arctic. For example, relapses did not occur with malarial cases. Certain doctors (Sinaskiy, Novoderzhin) also noted cures of chronic colitis and a number of other diseases of the gastrointestinal tract.

Scurvy, formerly the scourge of Arctic workers, is encountered very rarely now in thickly populated points. The characteristic form of illness for the Arctic is now S-hypovitaminosis. It is accompanied by infection of the oral cavity resulting in gingivitis, loosening of the teeth, and deterioration of the enamel. Caries appear rapidly in teeth and sometimes are of a gangrenous nature. In a number of cases, caries are accompanied by pyorrhea alveolaris. The spread of this disease can be laid presumably to the population's demand for demineralized snow water which lacks microorganisms, salt, and particularly, fluorine.

A considerable increase in tapeworm infections has been noted, due possibly to the eating of raw foods (stroganian, sugudat). Certain kinds of fish are undoubtedly helminth carriers. Determination of their forms will be the task of subsequent investigations.

Complaints of short-windedness and rapid heartbeat, especially during the polar night, are widespread, chiefly among newly arrived Arctic workers. It is possible that the etiological factors of short-windedness are due to an inadequate oxygen supply as a result of decreased hemoglobin in the blood and a decrease in the quantity and size of red corpuscles which takes place during the polar night. Subsequent investigation may disclose the nature of this phenomenon.

Of the Arctic workers we examined, about 17 percent had suffered from frost bite at one time or another. Rickets is the disease most prevalent among children. Nostalgia or longing for continental USSR is a widespread phenomenon. Eighty percent of the Arctic workers admitted having spells of nostalgia. They experience a feeling of elation when the sun first appears after the polar night, but this soon changes to a feeling of depression. When they go to work however, the nostalgia disappears.

With proper organization of work and rest periods, and with the creation of satisfactory housing, dietary and living conditions, the Arctic climate can prove to be beneficial to the organism. The severe weather fortifies a man.

What are the external human factors which determine the conditions of acclimatization and sanitation for the Arctic worker?

The constant population turnover is undoubtedly a factor which complicates work in improving village sanitation. The dwelling area on Dickson Island is not great. Of special interest is the high temperature (26-28 degrees) maintained in the dwellings which has a harmful effect. It weakens the organism and, hence, should be corrected.

The lighting system should be reorganized with the polar night especially in mind. Searchlight-type illumination for the streets and house lamps with

ultraviolet radiation would improve sanitary conditions. Experiments with quartz lamp irradiation during the polar night have disclosed a sharp increase in hemoglobin.

Special importance is attached to the question of radial heating for dwellings and plants with a view to establishing a thermal balance. An analysis has shown that the diet is adequate in calories, up to 4,000 for an adult, but not quite satisfactory in quality. It is monotonous, consisting mainly of canned goods with no fresh vegetables. An investigation should be made of the types of clothing and the conditions under which they are worn.

The work-rest schedule must have a definite rhythm for the course of the entire year. To preserve a normal physiological rhythm, and to be independent of climatic factors and changes from the polar day to the polar night is possible and practicable.

The special conditions of the Arctic call for original work by the public health services. Requests for medical aid in the Arctic are more than double those in continental USSR. From far distant corners they write "you feel better when there is a medical worker in the collective."

What are the prospects for further investigation? The year 1947 witnesses the beginning of the second stage of the investigations. Specific problems concerning the acclimatization process are being studied. Some of these problems required experimentation in special chambers, in laboratories, and in clinics.

For 1947 and for the Fourth Five-Year Plan, there are a number of important specific problems whose study is essential in the solution of the acclimatization problem in the Far North.

A list of some of the problems to be studied includes: the comparative nature of the microclimate of the eastern and western sectors of the Arctic from the point of view of its influence on the organism; the work-rest-sleep schedule for the polar night, the polar day, and the transition periods, and the preparation of an efficient schedule in conformity with the physical and mental aspects of labor; the basic physiological discomfort, with a view to discovering the dynamics of acclimatization and medical improvement, the reaction of the thermoregulatory system, the pulmonary and cardiovascular systems, and others; the sanitary features of inhabited localities; and the medical analysis of natural conditions and of housing resources.

Also, the sanitary planning of enterprises, port installations, and the cultural services network; the construction of water and sewerage systems; the elaboration of methods of using microelements to mineralize and enrich demineralized snow water; the elaboration of types and systems of polar-night illumination and the testing of daytime lighting; the microclimate of dwellings, the reason for the high temperature maintained in them, and the latter's effect on residents; the hygienic nature of the Arctic climate in connection with clothing and the design of efficient types of dress; the role of negative radiation in heat loss by the organism; the importance of radial heating and of special types of clothing in the establishment of a heat balance; the diet of various groups of the population; the vitamin needs of the Arctic population, both native and immigrant; helminthiasis and the consumption of raw food; diseases of immigrant and native peoples in the various zones; the etiology of appendicitis; the etiology of rickets in children and prophylactic measures; the characteristics of the spread and course of epidemic diseases in the Far North; and the Arctic mode of life from a hygienic point of view.

The study of acclimatization of the population will be a strong weapon for Soviet mastery of the Arctic.

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